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(54) CONVEYING APPARATUS

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(58) Field of Classification Search

See application file for complete search history.

(56) References Cited

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U.S. PATENT DOCUMENTS

4,763,776 A * 8/1988 Okumura B65G 27/00 198/630 6,185,084 B1 * 2/2001 Tai B03C 3/885 361/225

(Continued)

FOREIGN PATENT DOCUMENTS

JP 59-36271 2/1984 JP 2-206727 8/1990 (Continued)

OTHER PUBLICATIONS

Search Report issued in PCT/JP2014/076165 and English translation thereof, dated Dec. 22, 2014.

(Continued)

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(57) ABSTRACT

Provided is a conveying apparatus having simple mechanical and electrical configurations. The conveying apparatus includes: a conveying member that has a dielectric layer having insulating properties and made of an elastomer and a pair of electrode layers placed on both front and back sides of the dielectric layer and having conductive properties, and that is divided into a base portion and a conveying portion being more easily elastically deformed than the base portion and having on its surface a conveying path on which an object to be transported is transported; and a power supply unit that applies between the pair of electrode layers a voltage that changes periodically with time. The conveying portion is elastically extended and contracted with the base portion as a starting point according to a change in the voltage, so that the conveying apparatus transports the object on the conveying path.

13 Claims, 27 Drawing Sheets

